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Dust emissivity in the Submm/Mm SCUBA and SIMBA observations of Barnard 68

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We have observed the dark cloud Barnard 68 with SCUBA at 850 μm and with SIMBA at 1.2 mm. The submillimetre and millimetre dust emission correlate well with the extinction map of AlvesNature2001. The A$_V$/850 μm correlation is clearly not linear and suggests lower temperatures for the dust in the inner core of the cloud. Assuming a model for the temperature gradient, we derive the cloud-averaged dust emissivities (normalised to the V-Band extinction efficiency) at 850 μm and 1.2 mm. We find $\kappa_{850\mu m}/\kappa_V = 4.0 \pm 1.0 \cdot 10^{-5}$ and $\kappa_{1.2mm}/\kappa_V = 9.0 \pm 3.0 \cdot 10^{-6}$. These values are compared with other determinations in this wavelength regime and with expectations for models of diffuse dust and grain growth in dense clouds. Radiation mechanisms: thermal – dust, extinction – ISM: clouds, individual objects: Barnard 68 – Submillimeter – Radio continuum: ISM

AltonSub1999 JamesMNRAS2002 KramerAA1998 LadaApJ1994 HollandMNRASprep1998 NymanMsngr2001 BoulangerAA1996 BerginApJL2002 HotzelAA2002a MennellaApJ1998 AveryApJ1987 KramerAA2002
Introduction

Despite being a fundamental parameter in Far Infrared, Submillimetre and Millimetre astronomy, few measurements of the dust emissivityThe emissivity proper is the emission [absorption] cross section normalized to the geometrical cross section of a dust grain. Other authors prefer the cross section normalized to the mass of the grain. Both quantities are the same when normalised to the analogous quantity for V-band extinction.re available [for a review, see][]AltonSub1999,JamesMNRAS2002. The submm/mm dust emissivity is particularly important for star formation studies. Since molecules are known to deplete inside prestellar cores BerginApJL2002, dust emission may represent the best tracer of the gas density distribution just prior to the onset of gravitational collapse. Thus measurements in the submm/mm define the initial conditions from which a core collapses to form a star. Alternatively, the density distribution can be mapped through extinction, by measuring the near-infrared colour excess towards giant stars in the background of a cloud LadaApJ1994. High resolution and S/N maps can be obtained for object in the foreground of dense stellar fields AlvesNature2001.

This is the case for the dark cloud Barnard 68, a starless globule seen in the foreground of the Galactic Bulge. AlvesNature2001 have produced a high resolution extinction map of the cloud, measuring the H-K colour excess of nearly 4000 stars in its background. In this paper, we compare the extinction map with observations of submm/mm dust emission of similar resolution. Observations are described in Sect. obse. In Sect. ana we derive the dust emissivity from the correlation between emission and extinction (in a way similar to KramerAA1998,KramerAA2002). We will also adopt a temperature gradient within the cloud, which was derived from a model of dust heating. Finally, the derived emissivities are compared with other estimates from literature in Sect. conc.

Submm/mm Observations obse

figure*[!t] 12cm! El211$_f$1$l.epsEl211_f1r.epsSCUBAmapat850\mu$m (left) and SIMBA map at 1.2 mm (right) of Barnard 68, with superimposed A_V contours. The A_V and SCUBA maps have been smoothed to match the SIMBA resolution (FWHM=24; the beamsize is shown on the right image). All images have been resampled to a pixel size of 12. The field of view is 5×5. A_V contours start at 4 mag and are spaced by 4 mag. For both images, the grayscale in units of S/N. allmaps

r V-band extinction. a